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The Weather of 1932—a Varied Year

The year 1932 as a whole has not been remarkable either for heat or cold, drought or heavy rain. Full details for December are not yet available, but it is safe to say that over south-eastern England and over the British Isles as a whole temperature was less than a degree above normal, sunshine definitely below normal and rainfall slightly below normal. Some of the individual months have, however, presented outstanding features. The vagaries of the rainfall are described more fully in another article,* and the following account deals mainly with the temperature, winds and general weather conditions.

In January a persistent anticyclone covered the western Mediterranean and France, and for the greater part of the month extended its influence over most of the British Isles. The eastern parts of Great Britain enjoyed a good month, fine, dry and mild, but in the west the persistent strong south-westerly winds brought very heavy rainfall, and there were several widespread and destructive gales. Over the country as a whole the temperature was nearly 5°F. above normal.

In the last week of January pressure rose to a very high level over the British Isles, and intense anticyclonic conditions were maintained during the whole of February. At Malin Head the mean pressure for the month was as high as 1035·7mb, the

* *See* p. 275.

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highest monthly mean on record in these islands. The pressure distribution during this month was described and illustrated in the *Meteorological Magazine* for March, 1932. The weather was extremely dry; in Scotland it was mild and western Scotland enjoyed abundant sunshine, but southern England was dull and cold, with frequent fogs.

Anticyclonic conditions continued, but with greatly decreased intensity, during the greater part of March, which in the south was mainly fine and dry, with cold nights but moderately warm days. In the north the weather was dull, and eastern Scotland, owing to the prevalence of east winds, had an excess of rain. About March 20th there was a general fall of pressure and conditions were unsettled, cloudy and rainy throughout April. In the latter month the greatest deficit of pressure lay over southern Norway, and strong westerly winds predominated. The air supply was mainly of polar origin, and temperatures were from 1°F. to 3°F. below normal. In the north ground frost was frequent, and there were many falls of snow, sleet and hail with local thunder.

In May an extensive trough of low pressure extended from mid-Atlantic across Ireland and England to the Baltic. Weather was again cool, dull and rainy, only two-thirds of the normal sunshine being recorded over the country as a whole, and little more than half over central and southern England. England was excessively wet, with more than twice the normal rainfall. On the last day of the month the weather changed completely; an anticyclone over Iceland spread south-eastward and on June 4th became established over the British Isles, to persist with few changes until the 24th. June was as remarkable for dryness as May was for heavy rain, and in most districts the month was sunny. Temperature was high in the west, but owing to the frequency of light north-easterly winds the east of Great Britain was cooler than normal.

Once again the weather changed almost exactly at the end of the month, heavy rain setting in on the night of June 30th, and July was mainly dull and wet. Pressure was everywhere from two to four millibars below normal, and in an unstable westerly current widespread thunderstorms were frequent. Temperatures were for the most part moderate, but a hot spell from the 9th to 12th gave readings exceeding 80°F. in the east and Midlands, and reaching 86°F. in London on the 10th and 11th.

Unsettled and thundery conditions continued into the beginning of August, but on the 4th an anticyclone spread over the country and maintained its position for the greater part of the month, giving pressures 3 to 5mb. above normal. Weather was fine and exceptionally warm, but there were a number of severe local thunderstorms which caused the distribution of rainfall

to be very irregular. August 11th and 19th were notably warm; on the latter day temperatures exceeded 90°F. in many parts of southern England and the Midlands and reached 97°F. at Halstead in Essex and in several parts of London. At Camden Square this was the highest temperature registered since records began 74 years ago. A thermometer in the Glaisher Stand at Greenwich recorded 99°F., one degree lower than the famous maximum of August 9th, 1911. The month as a whole was 4·2°F. above normal in south-east England, and nearly 3°F. above normal over the country as a whole. Towards the end of August conditions became unsettled, and in September there was again a reversal. Pressure was more than 10mb. below normal over northern Norway and the low pressure extended over the British Isles, giving stormy westerly winds with dull weather and heavy rain. Temperatures were generally moderate, but there were two warm spells, from the 1st to 2nd and from the 14th to 17th; during the latter a temperature of 81°F. was recorded at Birmingham. Stormy conditions continued during October with a somewhat similar pressure distribution, but early in November pressure rose generally and the weather became drier and more settled. The most remarkable feature of the latter month, however, was the absence of sunshine, which at many places amounted to less than an hour a day. Only once (in 1888) since records began in 1880 has the total fallen short of the figure of 26 hours recorded at Kew Observatory. Fog was frequent, but temperatures were not abnormal. December was on the whole unusually mild and in most districts showed totals of sunshine above the average; in England and northern Scotland there was a large deficiency of rainfall. Easterly winds and low temperatures prevailed from the 6th to 11th, and in the western English Channel easterly gales occurred from 6th to 10th, but after the 12th mild south to south-west winds prevailed over most of the country.

The Rainfall of 1932

Perhaps more than usual interest was taken in the rainfall of 1932. Would it add yet another to the run of nine wet years, or would the sequence be broken at last? The general rainfall of 1932 approximated closely to the average in all countries, the provisional general percentages of the average, 1881 to 1915, being:—England and Wales 102, Scotland 106, Ireland 94, and the British Isles 101. The popular impression is that 1932 was a dry year, but it is only dry in comparison with the totals recorded during the last ten years. The total rainfall of 1932 was similar to that of 1929 and 1922, and it was most striking in Ireland, where it was the driest year since 1922. The rainfall

in Ireland would have been much more more noteworthy but for the wet December. The general percentage values were much smaller for Ireland than for England and Wales and Scotland, in April, September and October, while neither Ireland nor Scotland were as wet as England and Wales during May.

General values for each month are set out in the table below, as percentages of the average for the period 1881 to 1915 :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	%	%	%	%	%	%	%	%	%	%	%	%
England and Wales ...	111	18	88	156	221	59	144	56	144	153	69	47
Scotland ...	150	12	101	160	108	49	121	54	137	169	86	112
Ireland ...	122	7	71	118	134	60	138	62	109	105	58	138
British Isles ...	123	14	88	149	174	57	137	57	135	148	71	81

The corresponding general values in actual inches of rainfall are given below:—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
England and Wales...	3·3	0·5	2·3	3·3	5·1	1·4	4·1	1·9	3·7	6·1	2·4	1·8
Scotland ...	7·3	0·5	4·1	4·8	3·2	1·4	4·6	2·4	5·5	8·3	4·5	6·6
Ireland ...	5·0	0·3	2·4	3·2	3·7	1·7	4·6	2·6	3·4	4·3	2·5	6·9
British Isles...	4·6	0·5	2·8	3·8	4·5	1·5	4·4	2·2	4·2	6·3	3·0	3·8

The total rainfall over the British Isles during the winter half-year, October, 1931, to March, 1932, was 19·8 in. or 3·6 in. less than the average; that of the summer half-year, April to September, 1932, was 20·6 in. or 2·6 in. in excess of the average. It will be recalled that after about 1910 wet winters predominated, while of more recent years the excesses have been contributed mainly by wet summers. This was again the case in 1932.

During January there was a sharp contrast between the totals recorded in the west and in the east. More than twice the average fell in parts of Dartmoor, Cornwall and Sutherlandshire, while less than half the average occurred along parts of the east coast. As much as 34·7 in. was recorded on The Stye at the Head of Borrowdale, while the total at Tynemouth was only 0·58 in. The general rainfall over the British Isles during February was less than that recorded in any other month since comparable statistics became available in 1870. The rainfall of the six weeks January 21st to March 3rd was unusual in that while there was some rain everywhere in the British Isles, the amounts were small. The "spring" drought was experienced over an exceptionally large area, for at Keswick, in the English

Lake District, the total rainfall January 25th to March 3rd was only 0·06 in.; at Glenquoich, in the Western Highlands, for February 3rd to March 3rd only 0·44 in., and at Galway from January 25th to March 19th (54 days) only 0·54 in. Further details are given in an article on "The Spring Drought of 1932."*

The rainfall of March was noteworthy in Ireland, where the general fall was only 71 per cent. of the average. The rainfall of April was appreciably in excess of the average over England and Wales and over Scotland, but over Ireland the excesses were small. The rainfall of May was most remarkable over England and Wales, where the general fall amounted to 5·1 in. or 221 per cent. of the average, and May, 1932, probably ranks as the wettest May over that area during the last 160 years. The most striking rains occurred on the 1st, 2nd, 15th and from the 20th to 23rd, and the largest amounts occurred during the last period in the Midlands. The general rainfall over the catchment area of the River Don draining to Doncaster has been estimated at 0·64 in., 2·33 in., 0·48 in. and 0·16 in. for the four days 20th to 23rd respectively, a total of 3·61 in. immediately before the maximum flow. Captain J. C. A. Roseveare, in his paper on "Land Drainage in England and Wales" read before the Institution of Water Engineers, December, 1932, records that "water stood in the streets of Bentley for more than a month. Two collieries were directly affected by the floods, 33,000 manshifts being lost in a fortnight." Further details of the rainfall of May are given on pp. 119-21 of the June number of this magazine.

The rainfall of both June and August was appreciably less than the average, and the dry and warm periods during these months did much to create the popular impression of a good summer. Of the thunderstorm rains which occurred locally during July and August the most striking was that during the afternoon of July 11th at Cranwell Aerodrome, in Lincolnshire, when 4·96 in. was recorded in 120 minutes, of which 4·18 in. fell in 90 minutes. The rainfall of September was more variable than usual, some areas recording more than twice the average, while others received less than 80 per cent. October was the wettest month over the British Isles as a whole, and it was the wettest October since that of 1916. As in September and April the excesses were much less marked over Ireland than elsewhere. The rainfall of November was less than the average for the first time in seven years. The rainfall of December has been less than the average in most recent years, only one of the last eight receiving more than the average. In December, 1932, the rainfall was noteworthy for the marked contrast between that recorded in the east and west. At Camden Square (London)

* *See Meteorological Magazine* 67, 1932, pp. 67-9.

the total was only 0·47 in. At Rosthwaite in Borrowdale falls of 5·18 in. and 4·05 in. were recorded for the 16th and 17th respectively; while at Evan Water School, near Moffat in Dumfriesshire, the total for the six days December 14th to 19th amounted to 9·12 in.

In nearly all parts of the British Isles the total rainfall varied but little from the average, few stations reporting more than 120 per cent. or less than 85 per cent. In England and Wales less than 90 per cent. occurred near Brighton, Croydon, Enfield, Harpenden, Hull, Louth, Wakefield and along the east coast of Northumberland. More than 110 per cent. was recorded over Dartmoor, a large area between Swansea, Marlborough, Rugby and Shrewsbury, in the English Lake District and in parts of North Wales. Locally in these areas more than 120 per cent. was recorded. In Scotland less than 90 per cent. occurred in the extreme south-east and in the north-west. At both Stornoway in the Isle of Lewis, and Marchmont House, Berwickshire, there was 86 per cent. The largest percentage values occurred in the mountainous areas of the west and south-west, as much as 118 per cent. being recorded at Corran Lighthouse, to the south of Fort William, Inveraray Castle, Glasgow, Airdrie and New Cumnock, in Ayrshire. In Ireland the percentage values varied from about 85 per cent. in the south-west and west to rather more than 100 per cent. between Sligo and Omagh, and along the east coast.

J. Glasspoole.

Anemometers and the Beaufort Scale of Wind Force

The question of the relationship between the force of the wind as estimated on the Beaufort Scale and the velocity of the wind as determined by an anemometer is one which has for long exercised the minds of meteorologists. Tentative scales of equivalents are to be found in early books of instructions, but we may take as a starting point for the present note the publication in 1906 of a meteorological report entitled "Beaufort Scale of Wind Force" (Official No. 180). This contains an account of an investigation by Dr. G. C. Simpson which showed that for anemometers in open situations, with their vanes or cups at a height of about 10 metres (33 feet), the Beaufort number B was related to the wind velocity V, in miles per hour, by the equation $V = 1{\cdot}87\sqrt{B^3}$. Starting from this equation, two tables can be compiled. In one, by giving B the values 1, 2, 3, etc., in succession, the average value of the velocity equivalent to a given Beaufort number can be written down; in the other, by giving B the values ½, 1½, 2½, etc., in

succession, the range of velocity covered by the Beaufort numbers 1, 2, 3, etc., can be stated, thus providing a means for converting a measured velocity into a Beaufort number. In this way the official tables of velocity equivalents of the Beaufort numbers printed on pages 42-3 of the *Observer's Handbook* and on pages 32-3 of the *Meteorological Glossary* were prepared.

Observant readers of the *Monthly Weather Report* may have noticed that in recent months changes have been made in the tables relating to wind. In Table II (Summary of Autographic Records of Wind) a column has appeared with the heading "Effective Height," and in the Notes on the back page it is explained that "the effective height is an estimate of the height at which an anemometer would record an equal mean velocity in a situation free from obstructions." Also in regard to Table IV (Summary of Observations at Fixed Hours) there is a note that "at stations where there are anemographs the mean velocity for a period of about 10 minutes is converted to "force" on the Beaufort Scale by means of a table of equivalents appropriate to the exposure." In other words, official recognition has been given to the principle that the nature of the exposure of the anemometer must be taken into account when converting velocity to Beaufort force. The adoption of this principle implies that a scale of Beaufort equivalents appropriate to any anemometer can be drawn up if we have three pieces of information (1) a scale of equivalents for a standard effective height, (2) a formula showing the variation of wind velocity with height in an open situation, and (3) the effective height of the particular anemometer under consideration.

As regards (3) the effective heights of British anemometers have been carefully estimated by taking into account the surroundings of the anemometers and such knowledge as is available of the effect of obstructions on the speed of the wind: *the effective height is always less than the actual height.* As regards (2) the formula for variation of velocity (V) with height (h) which has been adopted by the Meteorological Office is Hellmann's formula:—

$$V = K\left(1{\cdot}00 + 2{\cdot}81 \log (h + 4{\cdot}75)\right)$$

where K is constant, and h is in metres. The value of the constant need not concern us because the formula is only required for the purpose of giving the ratio of the velocity V_h at height h to the velocity V_1 at the standard height h_1. This ratio is equal to

$$\frac{1{\cdot}00+2{\cdot}81 \log (h + 4{\cdot}75)}{1{\cdot}00+2{\cdot}81 \log (h_1+4{\cdot}75)}$$

The standard height has been taken to be 10 metres (33 feet) and the standard equivalents adopted for that height are those

found by G. C. Simpson, already referred to. In this way scales of Beaufort equivalents for any anemometer, the effective height of which is known, have been computed and are shown graphically in the diagram (fig. 1), where the upper and lower limits of each number on the Beaufort Scale are plotted as abscissæ with the effective height as ordinate. The broken line shows the value of the ratio $V_h/V_{10m.}$ To illustrate the effect of the change the scales are given below for the anemometers at Cardington (h=135ft.) and Aldergrove (h=20ft.), together with the standard scale (h=10 metres or 33ft.) formerly used at all stations.

Velocity Equivalents of Beaufort Numbers.
Limits of Velocity.

Beaufort Force.	*Cardington (h=135ft.) m.p.h.*	*Aldergrove (h=20ft.) m.p.h.*	*Standard Scale (h=33ft.) m.p.h.*
0	<1	<1	<1
1	1—4	1—3	1—3
2	5—9	4—7	4—7
3	10—16	8—11	8—12
4	17—23	12—16	13—18
5	24—32	17—22	19—24
6	33—41	23—28	25—31
7	42—50	29—35	32—38
8	51—61	36—42	39—46
9	62—72	43—50	47—54
10	73—84	51—58	55—63
11	85—99	59—69	64—75
12	over 99	over 69	over 75

It was decided to make no correction for height so long as the velocity computed from the formula does not differ by more than 5 per cent. from the standard value for a height of 10 metres; which is the case for anemometers having effective heights between 26 feet and 42 feet. The effective height of the majority of British anemometers is within these limits. In such cases the equivalents for a height of 10 metres have been retained; in all other cases the necessary allowance for height has been made since April 1st, 1932.

An important consequence of the change is that the number of " days of gale " printed in Table III of the *Monthly Weather Report* will tend to be reduced in the case of stations having high anemometers, and increased in the case of low anemometers. Hitherto anemometer stations have registered a day of gale when the " mean line " of the trace on the Dines instrument has reached a value of 39 m.p.h. or more at any time during the day. In future the occurrence of a gale will be determined by the lower limiting velocity corresponding to Force 8 as given

in the table appropriate to the particular instrument. When the effective height lies between 26 and 42 feet, the limit of 39 m.p.h. will continue to apply. It should be noted that in Table II of the report the previous practice of summarising velocities shown by the anemograph has been continued; consequently, in the case of anemometers with equivalent height outside the limits 26 and 42 feet the figures for frequency of different categories of wind speed in that table are not to be regarded as figures for frequency of Beaufort numbers.

To complete this note it is necessary to record certain additional facts. In 1921 the International Meteorological Committee asked Dr. G. C. Simpson to consider the question of a definite scale of equivalents between the Beaufort numbers and wind velocity. His conclusions are given in a paper entitled "The Velocity Equivalents of the Beaufort Scale" (Meteorological Office Prof. Notes, No. 44). Dr. Simpson proposed the following "code scale" for telegraphing wind velocities measured by anemometers, no matter what their height or exposure :—

	Limits of Velocity.	
Code Number.	m/s.	m.p.h.
0	0— 0·5	0— 1
1	0·6— 1·7	2— 3
2	1·8— 3·3	4— 7
3	3·4— 5·2	8—11
4	5·3— 7·4	12—16
5	7·5— 9·8	17—21
6	9·9—12·4	22—27
7	12·5—15·2	28—33
8	15·3—18·2	34—40
9	18·3—21·5	41—48
10	21·6—25·1	49—56
11	25·2—29·0	57—65

He was careful to point out that there was no such thing as a unique scale of equivalents between wind velocity and Beaufort force. For that reason he held that a "code scale" should be adopted for synoptic purposes, the numbers of which would agree approximately with the Beaufort numbers in the case of anemometers not at abnormal heights, but that these should not be described as Beaufort numbers. In a footnote he added that the "code scale" might be regarded as roughly equivalent to a Beaufort force scale for an anemometer at a height of 6 metres.

Dr. Simpson's report came before the International Meteorological Committee at Vienna in 1926 which adopted Dr. Simpson's table as a definite scale of Beaufort equivalents for a height of 6 metres. (Resolution XXII.) Provision was made in the resolution for the application of appropriate corrections

in determining the scale of equivalents for anemometers at other heights, but it was stated that the standard table should be used when such correction was less than 5 per cent. Taking 10 metres as the standard height for Meteorological Office anemometers, it was found that a scale computed for that height from the Vienna scale by Hellmann's formula agreed within 5 per cent. with the existing Meteorological Office scale. It was decided, therefore, to adhere to the Meteorological Office scale in the case of normally exposed anemometers in the British Isles, and to use it as the starting point in computing the scales

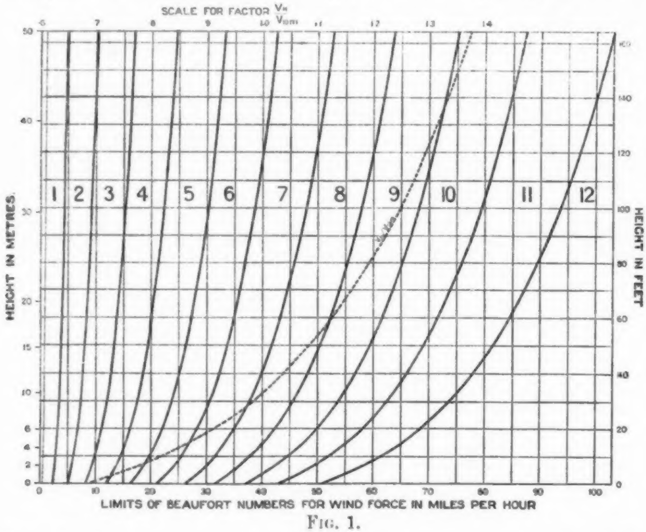


FIG. 1.

for abnormally exposed anemometers, an arrangement which involved the minimum amount of discontinuity in official wind statistics.

The conception of "effective height" is one about which controversy is almost inevitable, and it is perhaps advisable to explain a little more fully what is meant by the term. Suppose we set up two similar anemometers A and B on a wide level plain. Let A be erected on a slender mast to a height h, and suppose its recorder to be housed in an underground chamber so that the flow of air past the instrument is not disturbed in any way. Let B, on the other hand, be erected on the top of a building or among trees. Let the height of anemometer B be varied until the velocity it records agrees on the average with that recorded by A. Then the effective height of both

anemometers will be the same. It may be denoted by h. In the case of A, h will be equal to the actual height above ground, but in the case of B it will be less than the actual height. It is realised that the two anemometers will not show the same average velocity on all occasions, because the effect of an obstacle varies with the wind structure. The use of the "effective height" which, in practice, can generally only be estimated, must therefore be regarded in the broad sense. The results obtained from conversion tables based on effective height will be, on the average, definitely more comparable than they were before. The ideal scheme of things demands that all anemometers should be exposed at a standard height in open situations, but practical considerations often necessitate a departure from this ideal. By using scales of equivalents based on effective height we aim at restoring estimates of Beaufort force based on measured velocities to uniformity, and it is probable that a high degree of uniformity will actually be obtained so far as mean values are concerned.

Discussions at the Meteorological Office

The subjects for discussion at the two next meetings will be :—

January 30th, 1933.—*The change in climate of a big town.* By L. Besson (Ann. Hygiène, Paris, 9, 1931, No. 8) (in French). *Opener.*—Mr. W. C. Kaye, B.Sc.

February 13th, 1933.—*Electron bombardment as a factor in atmospheric phenomena.* By W. M. Cohn (Beitr. Geophysik, Leipzig, 37, 1932, pp. 198-223) (in German).—*Opener.*—Dr. C. E. P. Brooks.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 14th, in the Society's Rooms, 49, Cromwell Road, South Kensington, Prof. S. Chapman, F.R.S., President, in the chair.

C. S. Durst, B.A.—The Thermal Balance of a water drop or ice particle suspended in the atmosphere.

From the examination of the long wave radiation received and given out by a water drop or ice particle, it is shown that such a particle will lose heat if it is above a certain critical temperature and gain heat if it is below, from which it follows that if a particle exists in the stratosphere it will gain heat. It is assumed that the base of the stratosphere is saturated and consideration is given to the conditions under which particles could be formed. It is found that if a small air mass were raised in the stratosphere the particles formed in it would be melted in a very short time and the temperature of the air would once

more be that of its surroundings, the entropy of the air having been increased in the process.

Sir Gilbert T. Walker, C.S.I., Sc.D., F.R.S., and E. W. Bliss, M.A., M.Sc.—World Weather V. (Memoirs, Vol. 4, No. 36.)

In order to form more definite ideas regarding the North Atlantic, the North Pacific and the Southern oscillations, series of figures have been derived to express the variations of each, and from these have been obtained their relations with pressure, temperature, and rainfall over wide regions, as well as the relations of the three oscillations with each other and with sunspots.

The southern oscillation in the southern winter is found to be extremely persistent, and its departure has a correlation coefficient of ·84 with that of the following summer, thus providing a basis for foreshadowing seasonal conditions. The effects of Antarctic conditions and of ocean temperatures are considered, but a satisfactory physical basis for the oscillations has still to be found.

C. S. Durst, B.A.—The breakdown of steep wind gradients in inversions.

It is noticed on certain occasions when inversions have formed that a violent eddying arises, which is shown on an anemometer as an abrupt change in the type of trace. It is shown that this change over occurs when the wind gradient becomes great. On the ground that the eddies formed under these circumstances are different in character from those formed with an adiabatic temperature gradient a suggestion is put forward for the mechanism of the diurnal variation of wind.

Correspondence

To the Editor, *The Meteorological Magazine.*

The Colour of Moonlight

The following extract from Fleming's "Electric Lamps and Electric Lighting" bears on the question raised by Dr. Simpson in the November number of the *Meteorological Magazine.*

"On any bright moonlight night hold a white piece of card at the window, and place a candle so as to illuminate the card at about the same angle. Hold a pencil in front of the card and it will be seen that there are two shadows, one of which is a bright blue and the other a bright yellow. The yellow shadow is, apparently, the shadow thrown by the moon, and the blue shadow is, apparently, the shadow thrown by the candle."

I frequently observed, on bright moonlight nights in Malta brick red shadows of isolated street lamps, thrown by the moon on the grey limestone roadway; but the blueness of the shadows thrown by the lamps and illuminated by the moon was not so noticeable.

With regard to Mr. Bonacina's note that the sky lit by the

full moon after twilight is occasionally conspicuously blue, may not Mr. Bilham's observation be applied to explain this? The night sky is not dead black. It is illuminated, and the colour of the illumination is clearly not red or green. Ordinarily the average person would, I believe, call it bluish grey—of the "Air Force blue" tint. Moreover, the colour of the moon varies from white to red according to the amount of scattering of its light by the atmosphere. Is it not likely, therefore, that occasionally in the conditions accompanying west winds, mentioned by Mr. Bonacina, the blue, and the blue only, is strongly scattered, with a consequent absence of blue from the moonlight entering the eye, and enhanced scattered blue illumination of the sky?

L. A. HARWOOD.

January 3rd, 1933.

In the December issue of the *Meteorological Magazine*, Mr. Bilham raises the question whether the brightness of the blue sky in full moonlight, due to Rayleigh scattering, is great enough to be visible as blue light. The question is answered by the following computation.

The brightness of the clear blue sky in full daylight is about 4,000 candles/sq. metre. Sunlight is roughly 400,000 times as bright as moonlight. Therefore the brightness of the clear blue sky in full moonlight is about 0·01 candles/sq. metre.

It appears from the data given by Walsh* that the lowest brightness at which the colour of blue can be recognised is below 0·02 candle/sq. metre. The brightness of the clear blue sky in full moonlight is apparently therefore of the same order of value as the colour threshold, and the blueness of the light might possibly be recognisable.

M. G. BENNETT.

Kew Observatory, Richmond, Surrey. December 29th, 1932.

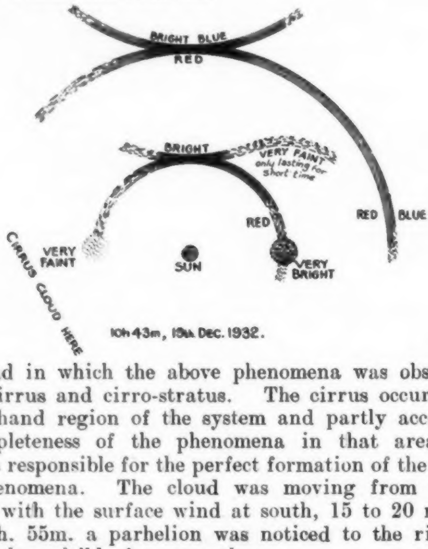
Solar Phenomena observed at Hastings

I give below a few observations on a fairly complete halo system which occurred here on December 19th last, which I trust may prove of some interest.

The halo system was first noticed at 10h. 41m., when there was a beautifully coloured halo of 46°, together with an arc of contact of equal intensity. The colouring of the 46° halo was very striking, and gave the impression of a narrow rainbow; the red was situated inside or towards the sun, and other colours were visible, including the blue on the outside. The junction of the arc with the halo was bright and distinctly coloured. A sketch of the system when almost complete at 10h. 43m. is given. In addition to the 46° halo an ordinary 22° halo with parhelia and upper contact arc was also visible. The parhelion to the right of the sun was very bright, while that on the left was

*See "Photometry," by Walsh. London, Constable & Co. Ltd., 1926.

only just distinguishable; the upper contact arc of this halo was faint, except at the junction of the arc and halo. The extremity of this contact arc was curved downwards and was very faint and only remained visible for a short time. The whole phenomenon rapidly faded as cloud increased in density, and by 11h. only the upper contact arc of the 46° halo and the two parhelia were visible, the latter, however, remaining very distinct. At 11h. 35m. an indistinct corona and a parhelion to the left of the sun were observed.



The cloud in which the above phenomena was observed consisted of cirrus and cirro-stratus. The cirrus occurred in the lower left-hand region of the system and partly accounted for the incompleteness of the phenomena in that area. Cirro-stratus was responsible for the perfect formation of the remainder of the phenomena. The cloud was moving from the south-south-west with the surface wind at south, 15 to 20 m.p.h. As early as 8h. 55m. a parhelion was noticed to the right of the sun remaining visible for some time.

A. E. Moon.

39, Clive Avenue, Clive Vale, Hastings. December 20th, 1932.

The halo phenomena described below was seen here on the morning of December 19th. The 22° halo was poorly developed being fragmentary and feebly coloured, but there was an unusually large arc of the 46° halo present coloured prismatically, and also the fully developed and brilliant circumzenithal arc, which looked like a miniature rainbow. The halo was first noticed at 10h. 45m.; by 11h. it had practically disappeared.

Cicely M. Botley.

Guildables, 17, *Holmesdale Gardens, Hastings. December 19th,* 1932.

The Swan Song of the Radcliffe Observatory

In Mr. Bilham's review of the "swan song" of the Radcliffe Observatory* there is one criticism to which we think it impor-

* *See Meteorological Magazine,* 67, 1932, p. 191.

tant that we should make reference. He rightly points out that the hours at which the maximum and minimum thermometers were read were not the same throughout the fifty years 1881-1930; and that we omitted to state explicitly when the changes took place. This was indeed an oversight, and we should be grateful if you could allow us space not only to rectify the omission, but also to give some figures which may be useful in rendering the mean minimum temperatures, as published, more homogeneous.

The figures printed for the mean maximum and minimum temperatures refer to the 24 hours ending at the hours shown in Table I for the different periods.

TABLE I

Period	*Terminal Hours* *Max.*	*Min.*
1881-1888	8	12
1889-1914	20	20
1915-1924	21	21
1925-1930	9	9

For the years 1915-24 the thermometers were also read at 9h., and there is thus available (see Tables II and III) a means of

TABLE II.

DIFFERENCES OF MEAN MAXIMUM TEMPERATURE AT OXFORD.
(Terminal hour 9 *minus* terminal hour 21)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec.
1915	−·1°	−·1°	−·3°	·0°	·0°	·0°	·0°	−·1°	·0°	+·1°	−·1°	−·1°
1916	−·3	+·1	·0	+·2	−·1	+·1	·0	0	−·1	+·1	+·1	+·4
1917	−·5	−·1	−·1	+·1	·0	·0	−·1	·0	−·2	−·2	+·3	·0
1918	+·5	−·1	+·1	+·4	−·3	·0	·0	−·1	·0	−·2	·0	−·1
1919	+·4	+·2	·0	−·2	0	−·2	−·3	−·2	−·2	−·1	+·1	+·2
1920	+·1	−·4	−·1	·0	·0	−·1	+·2	·0	+·1	+·2	·0	+·5
1921	+·2	·0	·0	+·1	·0	−·1	·0	·0	·0	−·3	−·3	+·6
1922	+·2	−·3	·0	·0	−·2	−·2	·0	·0	+·2	+·1	+·8	+·2
1923	+·5	+·1	·0	−·1	+·1	+·3	+·1	·0	·0	+·3	·0	+·2
1924	+·2	−·5	+·2	+·1	·0	·0	·0	+·1	+·1	·0	·0	+·7
Mean	+·1	−·1	·0	+·1	·0	·0	·0	·0	·0	·0	+·1	+·3

TABLE III.

DIFFERENCES OF MEAN MINIMUM TEMPERATURE AT OXFORD.
(Terminal hour 9 *minus* terminal hour 21)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov.	Dec
1915	+·1°	−·9°	+·1°	+·3°	+·3°	·0°	+·1°	+·2°	+·2°	−·8°	·0°	−·9°
1916	+·3	−·1	−·2	+·1	+·3	−·1	·0	+·1	+·4	·0	−·2	−·6
1917	+·2	−·9	−·6	·0	−·1	+·1	−·1	+·2	·0	·0	−·9	−·5
1918	−·6	−·8	−·2	−·4	+·2	+·1	·0	·0	+·5	−·1	−.1	−·1
1919	−·4	−·4	+·2	+·1	·0	+·3	·0	+·2	+·2	−·2	−·3	−·3
1920	−1·2	−1·4	−.5	+·1	+·1	+·1	·0	+·1	−·5	−·1	−1·3	−·4
1921	−·4	−·6	−·4	·0	+·1	·0	+·1	·0	+·5	−·2	−·6	−·9
1922	−·4	−·5	+·3	+·1	+·1	+·2	+·2	+·1	·0	·0	−1·2	−·9
1923	−·6	·0	−·3	−·3	+·4	+·2	+·1	+·1	+·1	+·1	−·6	−·3
1924	−·6	·0	−·2	−·1	+·1	+·1	·0	·0	·0	−·3	−·4	−·1
Mean	−·4	−·6	−·2	−·0	+·2	+·1	·0	+·1	+·1	−·2	−·6	−·5

reducing each individual monthly value during these years to the standard of 9h. as terminus, which may be thought desirable for the sake of comparison with other observations referred to this hour. We are, however, more concerned to reduce the whole series for the fifty years to a common standard, even though this can only be done in a statistical sense. The mean monthly differences in Table II are small enough to be neglected, and the figures, as printed, for the maximum temperature may be

TABLE IV.—DIFFERENCES OF MEAN MINIMUM TEMPERATURE AT KEW
(Terminal hour 21 *minus* terminal hour 12)

Month	*Difference*	*Month*	*Difference*	*Month*	*Difference*
January	—0·5	May	—0·1	September	—0·2
February	—0·3	June	—0·1	October	—0·5
March	—0·2	July	0·0	November	—0·6
April	—0·3	August	0·0	December	—0·6

considered as sufficiently homogeneous. As regards the minimum temperature, the same is true for the two periods 1889-1914 and 1915-24. The mean values given in Table III (with signs changed) can be used to correct those of the fourth period to the standard of 21h. as terminus, and the same can be done approximately for the years 1881-88, when the minimum thermometer was read at 12h., by application of the differences in Table IV, which are derived from Kew hourly values for 1901-10, and have been kindly supplied by Mr. Bilham.

H. KNOX-SHAW.
J. G. BALK.

Radcliffe Observatory, Oxford. November 30*th*, 1932.

Cloud Formation at the Cirrus Level by means of an Aeroplane

The formation of alto-cumulus by means of an aeroplane has been noted* on several occasions at this station. I am indebted to Flight-Lieut. White for an account of the formation of a cloud at a much higher altitude of 26,000 feet at about 15h. 30m. on October 27th, 1932. The ascent took the form of a steady climb in clear air throughout, the clouds present consisting of 3/10 of cumulus and 1/10 of alto-cumulus and cirrus. At a height of about 24,500 feet and a temperature of −45°F., the usual exhaust cloud began to form. Soon after, a dense stream of white solid-looking matter resembling the " steam " from a body taken out of a refrigerator appeared to originate at the nose of the machine, and came streaming over the wings. The cloud was far thicker than the usual exhaust cloud and totally obscured the pilot's view of the ground. About this time at a height of 26,000 feet (−51°F.) he first noticed the formation of

* *Meteorological Magazines*, 66, 1931, *p.* 89, *and* 67, 1932, *p.* 139.

ice on the windscreen and other parts of the machine, in particular the black nose had become white with hoarfrost. The cloud continued to form up to the ceiling of 27,000 feet (−56°F.) and also on the glide down until 25,000 feet (−47°F.) was reached, the engine being shut off in the latter stage. The ice accumulation did not disappear until a descent to 5,000 feet (35°F.) had been made. The cloud was not observed from the ground. Two further cases of the formation of cloud at these high altitudes have recently been brought to my notice, but unfortunately no details are available.

The description of the manner of formation of this cloud bears a strong resemblance to previous accounts of the formation of alto-cumulus by means of an aeroplane. The layer of formation about 2,000 feet or more is, however, deeper than that usually found in the case of alto-cumulus. The phenomenon of ice accretion would indicate that even at extremely low temperature it is still possible to meet water vapour.

W. H. Bigg.

Royal Aircraft Establishment, South Farnborough, Hants. *December 6th*, 1932.

NOTES AND QUERIES

A Warm Summer in 1778

The Countryman for July, 1932, contains a note by Mr. J. S. Ross describing a memorandum left by his great-great-grandfather, David Ross, born 1694, who farmed in Kincardineshire and lived to be over 80. The memorandum contains some interesting information about the state of crops in 1775 and 1778. Of the latter year he wrote: "In 1778 it was a bad seed time. But I never mind a warmer summer than it was. There was not a bad day from the tenth of May until the 9th and 10th of Oct^r. Both of them Stormy wind and Rain from the north but the Stoucks (sheaves) were for leading (carting) in four Days."

The Locking of Rain-gauge Funnels

The Meteorological Office was recently asked to provide a means of locking the funnels on two mountain rain-gauges to prevent removal by unauthorised persons. After inquiry, it did not appear that there was any recognised existing method of doing this, and it was, therefore, necessary to devise a method *de novo*. The straightforward plan seemed to be to provide two hasps which could be soldered or riveted to the funnel and container of the gauge, provision being made for locking the two together by means of a padlock. The difficulty of fitting such hasps to a gauge which was already installed in a mountain site would, however, in general, be considerable. The device shown in the

photograph which forms the frontispiece of this number of the magazine, which required no special fitting, was therefore evolved. A sufficient length of copper tube, 9/16 internal diameter, was procured and slit down its length to provide two pieces of semi-circular cross section. Each of these formed a locking device for one gauge. The half tube was bent into a circle of approximately the same diameter as the outside of the rain-gauge, and the two ends were shaped, one into a tongue and the other into a fork into which the tongue would readily slip. A hole drilled through both the fork and tongue permitted the attachment of a padlock. In use the ring is slipped over the two rims, the one on the funnel and the other on the container of the gauge, which butt against each other when the funnel is in position. The ring is then closed up and the padlock inserted. This prevents it being opened out sufficiently to permit of the funnel being withdrawn.

The gauges for which the fittings have been made are of the Octapent type, but a similar device could be used for any gauge where there are suitable rims on the funnel and container. The photograph shows a gauge with the ring and padlock in position, while a second ring detached from the gauge is shown on the left.

J. S. Dines.

Station at West Witton—Earth Thermometers for Disposal

We learn with much regret that Mr. J. B. Espiner, who has maintained a private climatological station at Ivy House, West Witton, Yorkshire, since 1910, has been compelled owing to ill-health to discontinue his observations other than those of rainfall. Representing the conditions 600 feet above sea level on the eastern slope of the Pennines, the West Witton observations were of more than ordinary interest. In addition to the usual readings, Mr. Espiner observed earth temperature at depths of 1 ft., 2 ft., and 4 ft. He wishes to dispose of the earth thermometers and anyone interested should communicate direct with Mr. Espiner at the address given above.

The Investigation of Cycles

A note* in the *Bulletin of the American Meteorological Society* describes briefly the proceedings at a meeting of a Committee of the National Academy of Sciences, Washington, formed to consider methods of studying cycles in natural phenomena. The discussion revealed that there are really two problems; the first is concerned with periodicities of a few days, months or years in length, many of which have been attributed to a solar origin.

*A symposium on climatic cycles. *Worcester, Mass., Bull. Amer. Meteor. Soc. Vol.* 13, 1932. Nos. 6-7, p. 121.

These can be investigated by direct observation of the sun or of meteorological elements. The second deals with cycles of much greater length, and is found in records covering periods of thousands of years. Prominent among these are the measurements of annual tree-rings, and the " varves " or annual layers formed in the fluvio-glacial sediments of retreating ice-sheets. The tree-records extend back for a period of more than 3,000 years; the varves also cover a very long period but have not yet been dated precisely. The main need is now to correlate the tree-rings and the varves, a problem which calls for the joint efforts of archæologists, geologists and tree-ring experts.

Reviews

On discontinuous fluid motion under different thermal conditions. By S. K. Banerji and V. M. Ghatagei, Indian Journal of Physics, Vol. III, Part 3. Calcutta University Press.

There are many phenomena which can be interpreted as due to turbulence arising on the breaking down of steady motion between two masses of fluid. The mathematical treatment of such problems present almost insuperable difficulties; but experimental study, though requiring great care, is in general feasible, and the present paper is a very good example of such work. The authors first examine the nature of the eddies set up between two masses of liquid of different densities at rest when the vertical partition between them is removed; they trace the effects of varying the conditions and are thereby enabled to get insight into the principles involved. Then they consider the situation in which there is discontinuity in motion as well as in density, making photographs to show the motion of individual particles as well as of the masses of liquid. The conclusions drawn are numerous and interesting. It seems doubtful whether the authors are right in thinking that Bjerknes' theory of the production of cyclones as waves on the polar front is sufficiently plausible to provide a meteorological application; but the eddies set up by convection currents are of considerable importance to aeronauts and light thrown on the subject will have practical value apart from its purely scientific interest, which is considerable.

G. T. WALKER.

Klima-Atlas für die Meeresheilkunde an der deutschen Seeküste. By Dr. C. Haeberlin and Dr. P. Perlewitz. Size $9\frac{1}{4} \times 12\frac{1}{2}$ in. Hamburg, 1932.

This atlas of 27 coloured charts has been compiled by a doctor of medicine and a well-known meteorologist in association, to assist in the utilisation of the German health and bathing

resorts. Each chart is accompanied by a succinct explanation, and the whole forms a useful work of reference. The atlas opens with charts of air temperature over Germany in July and January reduced to mean sea level; unreduced temperatures would have been more useful but are difficult to map. The third chart, however, shows the average duration of actual temperatures below 0°C. and brings out clearly the effect of the Atlantic in tempering the continental winter. Other charts of medical importance show the frequency of oscillations of temperature about the freezing point, the distribution of hot days, frosts and "ice-days" and the annual range of temperature. Two charts show the "continentality" of Germany and Europe; these are followed by a series dealing with pressure, winds, ocean currents and salinity. Rainfall is but little represented, presumably because the information is readily obtainable elsewhere, but curves of sunshine and ultra-violet radiation are given for Hamburg and Sahlenburg, under the heading of "optical climate." The last few charts illustrate the effect of climate on vegetation. The whole combines a large amount of not very accessible material in a handy form; the charts are clear and striking; in fact, some of them are almost too striking in the brilliance of their colouring. The price, 3M., is remarkably low.

Osiris and the Atom. By J. G. Crowther. Size $7\frac{1}{2} \times 5$ in., pp. viii + 221. *Illus.* London (Routledge), 1932. Price 5s.

Mr. Crowther is a scientific journalist and he has managed to compress into this little book an astounding variety of information on all sorts of topics from atomic physics to twins. The various sections are all most readable, and most of them, so far as the reviewer's limited knowledge goes, are reasonably accurate. The author has travelled widely in search of his material, and has talked with many interesting people. Osiris comes into the picture as one of the protagonists in a contest between life and death for the possession of a mummified Egyptian, supposed to be the origin of ball games, which in turn provide illustrations of atomic structure.

There are two chapters of special interest to meteorologists. The first deals with the great Siberian meteor, and is illustrated by reproductions of micro-barograms from England and by photographs of the devastated area. The account of the fallen trees, with a ring of upright trees among them indicating a "node" in the air-waves, is very good. The other meteorological section dealing with the causes of Thames floods is marred by a curious error, the normal atmospheric pressure at sea level being stated as 28 inches of mercury. There is also a section on "Cosmics," which includes an account of theories of the

earth's magnetism and a well-informed and restrained discussion of the possibility, or rather impossibility, of exploring space. "Osiris and the Atom" can be recommended as a pleasant book for holiday reading.

Winds, weather and currents on the coasts of India and the laws of storms.—India Meteor. Dept. Size $9\frac{1}{2}$ by 6 in., pp. 51, *Illus.* Calcutta, 1931. 4s. 3d.

The first part of the text is devoted to a short general account of the monsoons and land and sea breezes, followed by more detailed descriptions of the local meteorology of the various coastal regions, and an account of currents and tides. The recorded storm tracks are shown on a series of maps for various months. The remaining chapters deal with the "laws of storms" and rules for handling ships, and the system of visual signals for storm warnings at Indian ports, while a short appendix deals with navigation in the Bay of Bengal. A few minor misprints have been noted, but on the whole this pamphlet is a most useful and interesting summary. Not the least interesting section is the preface, which informs us that the information has been compiled in the Marine Section of the Poona Meteorological Office to meet the need of "a text-book to enable Indian seamen to study the laws of storms and the prevailing winds, weather and currents in Indian waters"—but what really brought matters to a head was apparently that in 1928 the Government of India "amended the rules for examination of candidates for certificates of competency as Masters and Mates of Steamships." Meteorologists, as well as those for whom this summary of conditions in India is intended, will find it useful.

S. T. A. Mirrlees.

Apia Observatory, Samoa, Annual Report for 1930. Size $9\frac{3}{4}\times$ 6 in., pp. iv + 71. Wellington, 1932.

This is the first report issued by the Apia Observatory since Mr. J. Wadsworth became Director on September 1st, 1930, in succession to Mr. A. Thomson. The report maintains its usual high standard, and provides a mass of valuable geophysical data which increases in importance with every year added to its already long series.

Books Received

Jaarboek, Koninklijk Nederlandsch Meteorologisch Instituut, 1930. A. Meteorologie, B. Aard-Magnetisme (Nos. 97 and 98). Utrecht, 1931.

Ergebnisse Aerologischer Beobachtungen, 1930. K. Ned. Meteor. Inst. (No. 106A). Utrecht, 1931.

Onweders, optische verschijnselen, enz. in Nederland. Naar vrijwillige waarnemingen in 1929. Deel 1, Amsterdam, 1931.

Obituary

Prof. Dr. A. Wigand.—We regret to learn of the death of Dr. A. Wigand, on December 18th, after a severe operation. Dr. Wigand was born at Kassel on October 12th, 1882, and was educated at Munich and at Marburg, where he took the degree of Ph.D. in 1905. He became an assistant in the Physical Institute at Marburg, and also taught at Dresden and in the University of Halle, where he was appointed Professor in 1917. At the time of his death he was Chief of the Section of Aerology, Meteorological Instruments and Research at the Deutsche Seewarte, Hamburg.

Dr. Wigand worked at first in the domain of pure physics, and especially on the physics of gases. These studies speedily found applications to the physics of the atmosphere, and he contributed a great number of meteorological papers to scientific journals. He was most interested in visibility and fog, and especially in the coagulation of water particles to form raindrops, which he studied both theoretically and by actual observation. In 1919 he invented a visibility meter. He also studied the distribution of condensation nuclei in the free atmosphere, the electrical conductivity in the upper air, and the neutral point of polarisation. In 1929, in association with Dr. August Schmauss, he wrote a remarkable book on "The Atmosphere as a Colloid," which aroused great interest; this book was reviewed in the *Meteorological Magazine* for 1929, p. 193. His last paper, "Experimental and theoretical studies on the coagulation of non-homogeneous fogs," appeared in the *Annalen der Hydrographie* for January, 1932.

News in Brief

As a result of the damage caused by the volcanic eruption of Mont Pelé in 1929, authority has been given for the establishment of a geophysical observatory on the island of Martinique in the West Indies. The main purpose of the observatory will be the study of vulcanology, but hurricane warnings will also be issued.

The annual meeting of the British Association for 1933 will be held in Leicester on September 6th-13th. Sir Gilbert Walker, Professor of Meteorology in the University of London, has been appointed president of Section A (Mathematical and Physical Sciences).

The Cambridge Philosophical Society has awarded the Hopkins prize for the period 1924-7 to Professor G. I. Taylor, Yarrow research professor of the Royal Society, for his researches on hydro-dynamics and on the de-formation of crystals.

Erratum

December, 1932, page 263, line 27, *for* " Mr. Kidson " read " Dr. Kidson."

The Weather of December, 1932

Pressure was above normal over southern Alaska, western Canada, the extreme western United States, the eastern United States, the St. Lawrence Region, Newfoundland, western North Atlantic, northern Africa and Europe, except for the extreme north and south-west, the greatest excesses being 10·4mb. at Prague and Lemberg, 6·1mb. at Juneau, and 4·0mb. at 50°N.50°W. Pressure was below normal over the central regions of Canada and the United States, Greenland, Spitsbergen, Iceland, eastern North Atlantic, south-west France, the western Iberian Peninsula, extreme northern Scandinavia and northern Russia. Temperature was above normal over the whole of western Europe, being as much as 13°F. above normal at Spitsbergen and between 11°F. and 14°F. in northern Sweden. Rainfall was mainly below normal, with 62mm. below normal at Zürich, and only 30 per cent. of the normal in southern and eastern Gothaland.

The outstanding feature of the weather of December over the British Isles was its unusual mildness except during a short period from the 6th-11th. The mean temperature for the month was 3·4°F. above normal at Aberdeen, 2·5°F. at Kew and 1·1°F. at Valentia. Sunshine was generally abundant except in the south-west of England, while rainfall was largely deficient in England and north Scotland but much above normal in Ireland and south Scotland; at Eskdalemuir it was the wettest December since records started there in 1910. The first day of the month was mild and sunny, but the weather became overcast and wet on the 2nd. On the 3rd and 4th northerly winds in the rear of the depression were associated with slight hail, sleet and snow in Scotland, north Ireland and the Midlands, but both days were generally sunny with 6·4 hrs. at Gorleston on the 3rd and 7·4 hrs. at Calshot on the 4th. Thunderstorms also occurred at Eskdalemuir and Aldergrove on the 3rd. On the 5th anti-cyclonic conditions developed over most of the British Isles and persisted until the 11th, but the south-west of Ireland and south-west England came under the influence of the depression centred off Portugal and easterly gales occurred frequently in the western English Channel from the 6th-11th. Temperature was low during this time, a maximum of 25°F. was recorded at Renfrew on the 6th, and of 26°F. at Dalwhinnie on the 8th, while even in Ireland maxima were generally below 45°F. The lowest minimum temperatures reported were 12°F. in the screen at Dalwhinnie on the 8th and 8°F. on the ground at Dalwhinnie on the 8th and 10th and 11°F. on the ground at Renfrew on the 7th. Slight sleet fell occasionally in the south and Midlands. As the anti-

cyclone moved away eastwards conditions became progressively milder with widespread fog on the 13th. For the remainder of the month deep depressions moving across the North Atlantic influenced our weather, giving southerly or south-westerly winds generally with gales in the west and north on the 15th-17th, 23rd-24th, 29th and 31st. At Lerwick a gust of 94 m.p.h. was recorded on the 17th. Temperature was high for the time of year, reaching 61°F. at Dublin on the 17th and 60°F. at Dublin and Llandudno on the 18th. On many days temperature during the day was higher in Scotland and north England than in the south. Night minima, too, were high, reaching 54°F. at Dublin and 53°F. at Durham, Valentia, Southport, Sealand and Liverpool on the 18th. Rainfall was heavy in the north and west from the 16th to 20th, at Rosthwaite, Borrowdale, 5·18 in. fell on the 16th and 4·05 in. on the 17th, at Eskdalemuir 3·14 in. on the 16th, 2·20 in. on the 17th and 1·77 in. on the 18th and at Fofanny (Co. Down) 2·27 in. on the 19th. Much sunshine was experienced locally from the 20th to 25th. Christmas Day was very sunny and mild over most of the country, 6·6 hrs. of bright sunshine were recorded at Rhyl, 6·5 hrs. at the Scilly Isles and Aberystwyth, 6·3 hrs. at Birmingham, 5·6 hrs. at Clacton and Brighton and 5·5 hrs. at Durham and Auchincruive. Inland in south-east England, however, there was much mist or fog and this spread over most of the country on the 26th, but cleared somewhat on the 27th and 28th. On the 31st another deep depression approached the western coasts bringing gales to west Scotland, Ireland and the western English Channel. A gust of 96 m.p.h. was recorded at Valentia at 4h. 35m. The distribution of bright sunshine for the month was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs.)
Stornoway	32	+ 9	Liverpool	44	+ 1
Aberdeen	39	+ 3	Ross-on-Wye	56	+14
Dublin	49	+ 1	Falmouth	40	—15
Birr Castle	50	+ 7	Gorleston	51	+ 6
Valentia	51	+10	Kew	49	+12

The special message from Brazil states that the rainfall was scarce in the northern regions with 1·54 in. below normal, irregular in the central regions with 0.08 in. below normal, and generally abundant in the southern regions with 2·01 in. below normal. Eight anticyclones passed across the country. The crops generally were in good condition except the corn. At Rio de Janeiro pressure was 0·5mb. below normal and temperature 2·5°F. above normal.

Miscellaneous notes on weather abroad culled from various sources. Snow fell generally in Switzerland early in the month so that by the 12th there was nearly a foot of snow over the whole

country. A heavy fall of snow was also reported over a wide area in the Lyons district on the 9th. Torrential rain about the 11th caused the Douro and Tagus to overflow, and parts of Oporto and the country round Santarem were flooded. On the 15th and 29th, Azov, Kherson and Nicolaieff were reported free of ice, and there was floating ice up to Kronstadt on the 15th. Owing to heavy rain part of a cliff at Alcala on the Jucar River, Spain, gave way on the 14th, and 10 villagers were killed. Heavy rain caused floods and damage to the crops and railways in the Perpignan district and in Catalonia about the 16th-18th. Navigation closed at Yxpila, Jacobstad, Vasa, Kristinestad and Kasko on the 21st. There was a small snowfall on the 27th in western Switzerland. Snow began to fall again in Switzerland on the 29th (*The Times*, December 7th-30th).

The Japanese destroyer *Sawarabi* foundered in a storm off Formosa on the 6th; 106 of her crew are missing. The long drought from which the Punjab was suffering was broken on the 21st with heavy rain in the plains and snow on the hills. Snow fell in Rawalpindi on the 29th, which is uncommon. Much welcome rain fell in central and southern Arabia during the month (*The Times*, December 6th-31st).

A storm in the Rockhampton district of Queensland about the 9th overturned a train and 15 passengers were injured. Heavy rain fell in Queensland from the 10th-13th, and in western Australia from the 17th-20th (*The Times*, December 10th and *Rainfall of Australia*).

Navigation in Montreal harbour closed for the winter months on the 7th and in Quebec on the 22nd. Abnormally severe cold was experienced in Canada in the first part of the month $-48°F.$ was reported from White River in northern Ontario on the 9th and from Doucet (Quebec) on the 16th, but on Christmas Day there was an abnormally rapid thaw in eastern Canada. Temperature was above normal over the United States during the first few days, but subsequently an intensely cold wave spread across the country, the mean temperature for the week ending the 13th was 36°F. below normal at Yellowstone Park and Lander. Rainfall was below normal during the first three weeks except in parts of the south-east States. Gales were encountered on the North Atlantic on the 14th, 15th, 20th and 27th-31st (*The Times*, December 19th-29th, and *Washington, D.C., U.S. Dept. Agric. Daily Weather Map and Weekly Weather and Crop Bulletin*).

Rainfall, 1932—General Distribution

	Dec.	Year.	
England and Wales ...	47	102	per cent of the average 1881-1915.
Scotland	112	106	
Ireland	138	94	
British Isles	81	101	

Rainfall: December, 1932: England and Wales.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond .	Camden Square	·47	20	*Leics* .	Belvoir Castle............	·68	28
Sur .	Reigate, Alvington ...	·67	21	*Rut* .	Ridlington	·65	26
Kent .	Tenterden, Ashenden...	·42	14	*Lincs* .	Boston, Skirbeck	·67	31
,, .	Folkestone, Boro. San .	·54	...	,, .	Cranwell Aerodrome ...	·55	25
,, .	Margate, Cliftonville...	·35	15	,, .	Skegness, Marine Gdns	·46	21
,, .	Sevenoaks, Speldhurst	·61	...	,, .	Louth, Westgate	·99	35
Sus .	Patching Farm	1·13	34	,, .	Brigg, Wrawby St. ...	1·12	...
,, .	Brighton, Old Steyne..	·60	19	*Notts* .	Worksop, Hodsock ...	·68	29
,, .	Heathfield, Barklye ...	·99	27	*Derby* .	Derby, L. M. & S. Rly.	·55	21
Hants .	Ventnor, Roy. Nat. Hos.	1·45	44	,, .	Buxton, Devon Hos. ...	2·00	35
,, .	Fordingbridge, Oaklnds	1·69	43	*Ches* .	Runcorn, Weston Pt...	1·25	40
,, .	Ovington Rectory	1·47	37	,, .	Nantwich, Dorfold Hall	1·03	...
,, .	Sherborne St. John ...	·88	27	*Lancs* .	Manchester, Whit Pk.	1·12	35
Berks .	Wellington College ...	·53	18	,, .	Stonyhurst College ...	2·27	47
,, .	Newbury, Greenham...	1·14	36	,, .	Southport, Hesketh Pk	1·64	51
Herts .	Welwyn Garden City...	·55	...	,, .	Lancaster, Strathspey	2·98	...
Bucks .	H. Wycombe, Flackwell	·65	...	*Yorks* .	Wath-upon-Dearne ...	·72	30
Oxf .	Oxford, Mag. College...	·70	30	,, .	Bradford, Lister Pk. ...	1·47	39
Nor .	Pitsford, Sedgebrook...	·99	41	,, .	Oughtershaw Hall	5·00	...
,, .	Oundle.....................	·35	...	,, .	Wetherby, Ribston H.	1·13	46
Beds .	Woburn, Crawley Mill	·48	23	,, .	Hull, Pearson Park ...	·91	38
Cam .	Cambridge, Bot. Gdns.	·28	15	,, .	Holme-on-Spalding ...	1·43	...
Essex .	Chelmsford, County Lab	·33	15	,, .	West Witton, Ivy Ho.	2·37	65
,, .	Lexden Hill House ...	·25	...	,, .	Felixkirk, Mt. St. John	1·14	47
Suff .	Haughley House..........	·39	...	,, .	Pickering, Hungate ...	1·41	56
,, .	Campsea Ashe............	·54	23	,, .	Scarborough	·92	39
Norf .	Norwich, Eaton.........	...	...	,, .	Middlesbrough	87	45
,, .	Wells, Holkham Hall	·52	25	,, .	Balderdale, Hury Res.	2·40	65
,, .	Swaffham, The Villa...	·94	38	*Durh* .	Ushaw College	1·22	49
Wilts .	Devizes, Highclere......	1·07	35	*Nor* .	Newcastle, Town Moor	·69	29
,, .	Bishops Cannings	1·10	34	,, .	Bellingham, Highgreen	3·25	89
Dor .	Evershot, Melbury Ho.	2·64	51	,, .	Lilburn Tower Gdns...	1·64	62
,, .	Creech Grange	1·77	40	*Cumb* .	Geltsdale..................	1·91	...
,, .	Shaftesbury, Abbey Ho.	1·56	43	,, .	Carlisle, Scaleby Hall	2·58	80
Devon .	Plymouth, The Hoe...	3·77	75	,, .	Borrowdale, Seathwaite	27·25	177
,, .	Launceston, Werringt'n	4·56	...	,, .	Borrowdale, Moraine...	21·59	...
,, .	Holne, Church Pk. Cott.	5·98	71	,, .	Keswick, High Hill...	9·51	142
,, .	Cullompton...............	3·04	69	*West* .	Appleby, Castle Bank	4·73	119
,, .	Sidmouth, Sidmount...	2·40	61	*Glam* .	Cardiff, Ely P. Stn. ...	2·13	41
,, .	Filleigh, Castle Hill ...	2·73	...	,, .	Treherbert, Tynywaun	6·76	...
,, .	Barnstaple, N. Dev. Ath	2·50	56	*Carm* .	Carmarthen Friary ...	4·35	76
,, .	Dartm'r, Cranmere Pool	6·00	...	*Pemb* .	Haverfordwest, School	4·45	78
Corn .	Redruth, Trewirgie ...	4·01	64	*Card* .	Aberystwyth	2·81	...
,, .	Penzance, Morrab Gdn.	3·28	58	,, .	Cardigan, County Sch.	4·53	...
,, .	St. Austell, Trevarna...	3·73	61	*Brec* .	Crickhowell, Talymaes	3·00	...
Soms .	Chewton Mendip	2·88	54	*Rad* .	Birm W. W. Tyrmynydd	4·32	53
,, .	Long Ashton	1·60	41	*Mont* .	Lake Vyrnwy............	3·37	49
,, .	Street, Millfield.........	1·81	53	*Denb* .	Llangynhafal	1·43	43
Glos .	Blockley	·87	...	*Mer* .	Dolgelly, Bryntirion...	4·35	43
,, .	Cirencester, Gwynfa ...	·93	28	*Carn* .	Llandudno	2·10	68
Here .	Ross, Birchlea............	1·75	59	,, .	Snowdon, L. Llydaw 9	17·45	...
,, .	Ledbury, Underdown..	1·29	46	*Ang* .	Holyhead, Salt Island	4·34	104
Salop .	Church Stretton.........	1·76	52	,, .	Lligwy......................	4·26	...
,, .	Shifnal, Hatton Grange	·95	37	*Isle of Man*			
Worc .	Ombersley, Holt Lock	1·04	40		Douglas, Boro' Cem. ...	5·73	114
War .	Birminghm, Edgbaston	1·07	40	*Guernsey*			
Leics .	Thornton Reservoir ...	·71	26		St. PeterP't. Grange Rd	1·72	42

Rainfall: December, 1932: Scotland and Ireland.

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt .	Pt. William, Monreith	5·45	120	*Suth* .	Melvich	1·95	...
,, .	New Luce School	5·68	102	,, .	Loch More, Achfary	6·17	67
Kirk .	Carsphairn, Shiel	16·83	181	*Caith* .	Wick	2·01	65
Dumf .	Dumfries, Crichton, R.I	7·19	178	*Ork* .	Pomona, Deerness	2·73	65
,, .	Eskdalemuir Obs.	13·37	191	*Shet* .	Lerwick	2·59	54
Roxb .	Branxholm	5·47	150	*Cork* .	Caheragh Rectory	7·96	...
Selk .	Ettrick Manse	12·79	207	,, .	Dunmanway Rectory	10·50	131
Peeb .	West Linton	6·50	...	,, .	Ballinacurra	7·35	143
Berw .	Marchmont House	1·81	64	,, .	Glanmire, Lota Lo.	8·04	146
E. Lot .	North Berwick Res.	2·34	109	*Kerry* .	Valentia Obsy.	8·22	124
Midl .	Edinburgh, Roy. Obs.	4·80	205	,, .	Gearahameen	19·10	...
Lan .	Auchtyfardle	8·09	...	,, .	Killarney Asylum	8·83	121
Ayr .	Kilmarnock, Kay Pk.	7·22	...	,, .	Darrynane Abbey	7·59	129
,, .	Girvan, Pinmore	8·38	140	*Wat* .	Waterford, Gortmore	8·02	175
Renf .	Glasgow, Queen's Pk.	8·34	187	*Tip* .	Nenagh, Cas. Lough	5·96	129
,, .	Greenock, Prospect H.	12·21	155	,, .	Roscrea, Timoney Park	4·76	...
Bute .	Rothesay, Ardencraig.	7·27	...	,, .	Cashel, Ballinamona	6·13	141
,, .	Dougarie Lodge	6·68	...	*Lim* .	Foynes, Coolnanes	5·19	110
Arg .	Ardgour House	14·66	...	,, .	Castleconnel Rec.	4·83	...
,, .	Glen Etive	16·57	134	*Clare* .	Inagh, Mount Callan	7·60	...
,, .	Oban	7·04	104	,, .	Broadford, Hurdlest'n.	5·82	...
,, .	Poltalloch	7·15	113	*Wexf* .	Gorey, Courtown Ho.	7·49	196
,, .	Inveraray Castle	14·50	146	*Kilk* .	Kilkenny Castle	4·54	131
,, .	Islay, Eallabus	5·85	99	*Wick* .	Rathnew, Clonmannon	5·91	...
,, .	Mull, Benmore	12·40	...	*Carl* .	Hacketstown Rectory	6·33	154
,, .	Tiree	...	...	*Leix* .	Blandsfort House	5·44	148
Kinr .	Loch Leven Sluice	6·46	164	,, .	Mountmellick	6·56	...
Perth .	Loch Dhu	...	...	*Offaly* .	Birr Castle	4·35	132
,, .	Balquhidder, Stronvar	9·93	...	*Kild'r.*	Monasterevin	...	...
,, .	Crieff, Strathearn Hyd.	8·06	180	*Dublin*	Dublin, FitzWm. Sq.	3·87	156
,, .	Blair Castle Gardens	5·05	132	,, .	Balbriggan, Ardgillan.	4·52	156
Angus .	Kettins School	4·30	130	*Meath* .	Beaupare, St. Cloud	4·70	...
,, .	Dundee, E. Necropolis	...	...	,, .	Kells, Headfort	5·38	141
,, .	Pearsie House	5·49	...	*W. M.*	Moate, Coolatore	4·30	...
,, .	Montrose, Sunnyside	...	...	,, .	Mullingar, Belvedere	5·19	141
Aber .	Braemar, Bank	5·61	158	*Long* .	Castle Forbes Gdns.	5·61	141
,, .	Logie Coldstone Sch.	1·67	59	*Gal* .	Ballynahinch Castle	7·73	103
,, .	Aberdeen, King's Coll.	1·41	44	,, .	Galway, Grammar Sch.	...	...
,, .	Fyvie Castle	1·17	34	*Mayo* .	Mallaranny	8·70	...
Moray	Gordon Castle	1·68	62	,, .	Westport House	7·01	122
,, .	Grantown-on-Spey	...	...	,, .	Delphi Lodge	14·36	118
Nairn.	Nairn	1·86	84	*Sligo* .	Markree Obsy.	6·32	132
Inv's .	Ben Alder Lodge	8·99	...	*Cavan.*	Belturbet, Cloverhill	4·17	113
,, .	Kingussie, The Birches	3·38	...	*Ferm* .	Enniskillen, Portora	...	...
,, .	Loch Quoich, Loan	14·10	...	*Arm* .	Armagh Obsy.	4·94	158
,, .	Glenquoich	12·25	83	*Down* .	Fofanny Reservoir	10·26	...
,, .	Inverness, Culduthel R.	2·28	...	,, .	Seaforde	6·20	150
,, .	Arisaig, Faire-na-Squir	5·30	...	,, .	Donaghadee, C. Stn.	5·17	162
,, .	Fort William, Glasdrum	12·36	...	,, .	Banbridge, Milltown	4·24	147
,, .	Skye, Dunvegan	5·24	...	*Antr* .	Belfast, Cavehill Rd.	6·10	...
,, .	Barra, Skallary	...	...	,, .	Glenarm Castle	...	...
R & C .	Alness, Ardross Castle	3·26	79	,, .	Ballymena, Harryville	6·03	136
,, .	Ullapool	4·35	69	*Lon* .	Londonderry, Creggan	5·06	115
,, .	Achnashellach	8·75	87	*Tyr* .	Omagh, Edenfel	5·70	135
,, .	Stornoway	3·84	61	*Don* .	Malin Head	3·89	...
Suth .	Lairg	2·03	50	,, .	Dunfanaghy	5·30	...
,, .	Tongue	2·61	53	,, .	Killybegs, Rockmount.	4·09	56

Climatological Table for the British Empire, July, 1932

STATIONS	PRESSURE Mean of Day M.S.L. mb.	PRESSURE Diff. from Normal mb.	TEMPERATURE Absolute Max. °F.	TEMPERATURE Absolute Min. °F.	Mean Values Max. °F.	Mean Values Min. °F.	Mean Values ½ max. and min. °F.	Mean Values Diff. from Normal °F.	Mean Wet Bulb °F.	Relative Humidity %	Mean Cloud Am'nt 0—10	PRECIPITATION Am'nt in.	PRECIPITATION Diff. from Normal in.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible
London, Kew Obsy.	1012·5	— 3·3	84	46	70·3	55·2	62·7	0·0	57·2	84	7·4	2·45	+ 0·28	13	4·5	28
Gibraltar	1015·1	— 1·7	86	58	80·5	64·8	72·7	— 2·1	63·0	79	3·6	0·00	— 0·03	0	..	..
Malta	1013·8	— 0·9	88	66	81·6	70·5	76·1	— 2·2	70·2	77	3·5	0·00	— 0·05	0	11·1	77
St. Helena	1018·5	+ 1·6	62	52	59·6	53·7	56·7	— 1·8	54·6	94	9·2	5·42	..	24	..	..
Sierra Leone	1014·7	+ 2·0	87	69	81·3	72·2	76·7	— 1·9	74·9	93	9·3	31·99	— 3·59	24	..	..
Lagos, Nigeria	1014·5	+ 1·3	84	71	82·1	73·8	77·9	— 0·1	72·8	83	9·2	0·86	— 9·64	9	5·7	46
Kaduna, Nigeria	1015·2	+ 0·3	88	65	82·0	68·2	75·1	+ 1·5	70·3	86	9·0	2·66	— 7·96	11	4·7	37
Zomba, Nyasaland	1017·1	— 1·4	79	44	73·1	50·5	61·8	— 0·2	..	69	5·5	0·13	— 0·22	2	..	..
Salisbury, Rhodesia	1022·3	— 0·7	75	32	69·3	40·8	55·1	— 1·0	47·9	54	2·2	0·00	— 0·03	0	8·7	78
Cape Town	1021·9	+ 0·6	73	39	61·5	46·7	54·1	— 0·6	48·0	90	5·6	2·56	— 1·06	11	..	..
Johannesburg	1022·8	— 0·8	69	26	60·1	39·4	49·7	— 0·7	37·3	36	0·7	0·00	— 0·33	0	10·1	94
Mauritius	1019·3	— 1·1	76	56	74·8	62·2	68·5	+ 0·2	65·3	73	4·5	1·10	— 1·39	24	7·7	70
Calcutta, Alipore Obsy.	997·1	— 2·1	93	75	88·6	79·5	84·1	+ 0·4	79·8	91	8·9	9·87	— 2·83	19*	..	..
Bombay	1002·0	— 1·9	90	73	85·4	76·8	81·1	— 0·3	77·4	87	9·1	35·30	+ 11·03	24*	..	..
Madras	1003·3	— 1·2	100	76	96·0	79·9	87·9	+ 0·3	75·3	65	7·9	0·84	— 3·00	3*	..	..
Colombo, Ceylon	1008·7	— 0·4	87	71	85·2	76·9	81·1	— 0·1	77·0	79	7·4	1·56	— 2·87	10	6·8	54
Singapore	1008·5	— 0·4	91	70	87·1	75·7	81·4	+ 0·1	77·4	81	6·7	10·00	+ 3·21	12	6·6	54
Hongkong	1004·7	0·0	90	75	85·8	78·2	82·0	— 0·5	78·3	82	8·0	25·71	+ 11·29	23	6·1	46
Sandakan	..	..	90	70	86·9	74·9	80·9	— 0·9	76·3	84	7·6	9·68	+ 2·96	19	..	..
Sydney, N.S.W.	1016·6	— 1·7	67	38	61·6	44·4	53·0	+ 0·3	47·4	76	4·5	2·57	— 2·23	9	6·2	61
Melbourne	1018·1	— 0·8	62	33	55·7	42·0	48·9	+ 0·2	44·0	81	6·5	1·89	+ 0·03	19	3·7	37
Adelaide	1018·9	— 1·4	64	38	59·4	45·5	52·5	+ 0·7	47·9	75	7·3	2·64	0·00	19	4·2	42
Perth, W. Australia	1018·1	— 0·9	68	42	63·4	49·9	56·7	+ 1·5	51·5	74	6·6	9·72	+ 3·16	20	5·1	50
Coolgardie	1019·9	+ 0·1	76	33	61·7	41·1	51·4	+ 0·2	45·9	72	4·0	0·37	— 0·50	4	..	..
Brisbane	1017·8	— 0·6	75	42	68·9	47·7	58·3	— 0·2	50·4	65	2·5	0·27	— 2·01	5	8·4	79
Hobart, Tasmania	1017·5	+ 3·8	60	32	52·0	39·5	45·7	0·0	41·2	81	6·4	2·20	+ 0·02	10	4·1	44
Wellington, N.Z.	1016·3	+ 2·4	61	33	49·4	39·4	44·4	— 3·6	42·0	79	6·4	1·48	— 4·15	14	4·1	43
Suva, Fiji	1012·3	— 1·7	87	65	79·6	69·9	74·7	+ 1·3	70·8	83	6·3	15·04	+ 10·11	20	4·5	40
Apia, Samoa	1010·4	— 1·5	88	69	84·9	74·4	79·7	+ 2.5	75·9	76	4·5	2·42	— 0·56	15	8·0	70
Kingston, Jamaica	1013·5	— 1·2	92	71	90·2	73·7	81·9	+ 0·2	72·3	76	6·4	0·86	— 0·76	2	8·9	68
Grenada, W.I.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Toronto	1011·0	— 3·4	87	50	76·1	59·1	67·6	— 1·5	61·1	74	4·0	3·56	+ 0·72	14	8·6	57
Winnipeg	1013·3	+ 1·0	90	41	78·0	56·2	67·1	+ 0·7	57·5	87	4·9	2·46	— 0·64	12	9·4	59
St. John, N.B.	1008·3	— 5·3	81	49	69·0	53·3	61·1	+ 0·7	58·0	80	5·9	8·73	+ 5·10	20	6·8	44
Victoria, B.C.	1017·2	— 0·1	74	48	63·5	50·8	57·1	— 3·0	53·6	78	5·9	1·93	+ 1·51	11	7·7	49

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

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